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Scarlet Fever:
Dick and Schultz-Charlton Tests, Active and Passive Immunity.

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THE intention of this short paper is to review the present position in connexion with the various scarlet fever tests and to indicate the many blanks in our knowledge and the points that especially require investigation.

DICK TEST.

(*a*) In General Population.—The general figures obtained in England resemble those found by American workers. Thus, Dr. E. H. R. Harries, of Birmingham, who has kindly allowed me to quote several of his recent results, finds the following percentages of positive reactors in successive age periods: Age 0–5, 70 per cent.; 5–10, 64 per cent.; 10–15, 56 per cent.; 15–20, 11 per cent.; total individuals tested, with no previous history of scarlet fever, 225. In a further group of 152 children, the following figures were obtained: Age 0–5, 100 per cent. (S.100); 5–10, 74 per cent. (S.68); 10–15, 52 per cent. (S.52); over 15, 46 per cent. (S.36). Of these children 23 gave a previous history of scarlet fever; 3 of these were Dick positive reactors, 20, *i.e.*, 84 per cent., were negative. (In the bracket following the Dick positive percentage is given the Schick positive percentage result, preceded by the letter S.)

(*b*) In People with a History of Scarlet Fever.—In a group of 77 people with a previou history of scarlet fever, 3 only were positive reactors, *i.e.*, 96 per cent. gave negative reactions.

(*c*) In Nurses.—Dr. Harries found that of 100 nurses tested after various periods of work in scarlet fever wards, 11 per cent. gave a positive reaction. Thirty-three of the nurses had a definite history of scarlet fever; all gave a negative reaction to the Dick test.

(*d*) In Scarlet Fever Patients.—Table 1 (taken by permission from an unpublished paper by Dr. E. H. R. Harries) gives results which broadly agree with those obtained by American workers.

TABLE 1. DICK TESTS ON 200 CASES OF DEFINITE SCARLET FEVER (Dr. E. H. R. Harries). (1–1,000 dilution of X.48.)

Days of Disease.	Positive.	Negative.	Total.	Percentage Positive.	Dr. Smith.	
					Days of Disease.	Percentage Positive.
1st–4th	26	7	33	79	1st–2nd	86
					3rd	70
					4th	60
5th–7th	17	22	39	43·5	5th	52
					6th	42
8th–17th	13	40	53	24·5	7th–14th	27
18th–31st	1	20	21	4·7		
Over 31st	2	52	54	3·7		
	59	141	200			

In column 6 are shown the figures representing day of disease and percentage of Dick positive reactors from the paper by Dr. Smith, of Aberdeen (*Journal of Hygiene*, March, 1926). It is of great interest that the percentage of negative reactions rises so rapidly. Patients evidently begin to develop immunity within a few days of the onset of the disease. Ninety-six per cent. of the patients tested 31 days after recovery from the disease were negative to the Dick test.

BACTERIOLOGY AND TOXIN PRODUCTION.

The identification of the streptococcus of scarlet fever is a matter of great importance and at present one of considerable difficulty.

The specific streptococcus (*a*) has recognised fermentation reactions;
(*b*) is hæmolytic;
(*c*) usually agglutinates and "absorbs" with specific agglutinating scarlet fever serum;
(*d*) makes "toxin" neutralisable by specific antitoxin and causing "miniature scarlet fever";
(*e*) causes scarlet fever when administered to Dick positive reactors.

If one has a suspected carrier to deal with one may easily isolate the organism and use tests (*a*) and (*b*). The agglutination tests are more difficult to apply. Several pathologists in England are investigating this aspect, but there is no agreement at present that this test is satisfactory or easy to apply.

The American workers have apparently sharply differentiated the erysipelas group and found that the great majority of scarlet fever strains conform to these tests, but it is not easy to be certain that every strain which does agglutinate and "absorb" is the specific streptococcus. The (*d*) group of tests are not therefore easy to apply; one must after making the filtrate find if it gives a reaction in Dick positive reactors and whether it is neutralisable by specific serum. It is obviously not easy in practice to discover if it causes "miniature scarlet fever," *i.e.*, temperature, vomiting, rash, and "strawberry tongue," all lasting 24 or 48 hours. Test (*e*) can be applied only under very unusual circumstances; probably only two or three strains have been clearly identified by this method of proof. It must be remembered that we are not at present quite certain that there may not be more than one type of scarlet fever streptococcus.

If one finds a hæmolytic streptococcus in the throat of a person who, there is strong reason to suspect, is a "carrier" of scarlet fever, one would be impelled to consider the individual as a probable carrier and to take whatever measures one could by way of reduction of risk to those in close association.

In connexion with the identification of toxin, there is but little new to report. My colleagues, Dr. Okell and Dr. Parish, have made a very large number of tests in an attempt to find a laboratory method of testing toxin and, conversely, antitoxin. Considerable numbers of available mammals and birds have been used, but hitherto without success. Recent tests on ferrets have unfortunately failed. Dr. Wadsworth and Miss Kirkbride use goats for the purpose, but the method is not easy, and many goats are naturally insensitive to these toxins. This method we are again investigating. We have also the following methods of test in progress, but none of them offer much hope of success: (*a*) Flocculation, (*b*) Long's intratesticular (tuberculin) method, (*c*) Dochez-Shermann guinea pig sensitisation with streptococci, (*d*) Besredka "pansement," (*e*) production of intradermic lesions with living streptococci, and neutralisation or protection with specific antitoxic or bactericidal serum.

Schultz-Charlton Test.

When using 0·2 c.c. of a good antitoxic serum diluted ten times, one does not always get 100 per cent. of positive blanching reactions in scarlet fever. We made the suggestion previously that the percentage may be higher if the amount of serum used were increased ; one might for the intradermic test use 0·8 c.c. or even 1 c.c. of undiluted antitoxin. Recent results, however, suggest that it may be worth while using also a greater dilution. There is some reason for believing that a patient slightly sensitive to horse serum may yield a flush due to serum sensitiveness which may obscure or overcome any blanching due to the true Schultz-Charlton action. It would seem, therefore, well worth while that a series of tests with 0·2 c.c. of three different dilutions in parallel should be carried out ; dilutions of 1/2, 1/10 and 1/100 may be used. Probably 50 or 100 such tests carried out in the first 70 hours of the rash would show definitely what is the best routine dilution to use.

Active Immunisation.

It appears to be fairly certain that a quantity of about 1,000 minimal skin doses will cause "miniature non-infectious scarlet fever," *i.e.*, temperature, rash, vomiting and sore throat in the majority of patients. Probably, therefore, it will be found that the best dose to commence immunisation with is that in use at present, *i.e.*, from 250 to 500 minimal skin doses. Probably some such course as 500, 1,000, 2,000, 5,000 will be found to give a reasonably high and lasting immunity without producing any severe reactions during immunisation.

Antitoxin : Titration.

It is of interest that Blake and Trask in a recent paper speak rather favourably of the method of titration by the determination of blanching titre and suggest that the titre be based on minimal blanching dose (M.B.D.). This method we have been advocating and using for some considerable time past. If it continues to give in practice at least as regular results as the American official skin neutralisation method, we shall welcome it, for it is much easier to carry out.

Antitoxin : Passive Immunity.

Much more experience is necessary before clinicians will be able to decide with confidence what is the best dose of a reasonably good serum to give. It is fairly clear from our experience that 10 c.c. of a reasonably good serum will convert all Dick positive reactors into negative overnight and keep them negative and give protection against scarlet fever for many days. We have found that quantities as small as 2·5 c.c. or 3 c.c. will in many patients convert a positive reaction to negative.

Antitoxin : Treatment.

Evidence accumulates on all sides that serum treatment is highly effective, particularly in early toxic cases. Clinicians in charge of late septic cases occasionally see great improvement after the use of antitoxic serum. Others do not find serum of use in these late septic cases. A possible explanation is that some late septic cases are still Dick positive, *i.e.*, are suffering from a toxæmia as well as a "pyogenic" attack by the streptococcus and that if one can help the patient to combat his toxæmia, he can himself deal with the pyogenic attack. Much more careful observation of these patients is necessary before this point can be fully understood.

Problems needing Further Investigation.

(1) Immediate practical questions, such as (*a*) the stability of Dick toxin test solution (apparently it keeps for many weeks), (*b*) stability of diluted antitoxin for Schultz-Charlton test ; (apparently for some months).

(2) The rate of disappearance of hæmolytic streptococci from the throats of scarlet fever patients.

(3) The Dick test reaction and response to serum in late septic cases.

(4) The relation of therapeutic efficiency to blanching titre of serum.